crp 1

SUPPLEMENTAL IRRIGATION IN THE EASTERN STATES

by

F E STAEBNER, DRAINAGE ENGINEER
Bureau of Agricultural Engineering, U.S.D.A.

Presented before the North Atlantic Section of A.S.A.E.
Skytop, Pennsylvania, October 16, 1936

- - - - - -

The biggest problem in supplemental irrigation is that of determining the real need, or the real advantage, of adding this practice to the farm program in any individual instance. We have all seen many periods of dry weather of greater or less duration during which we have felt that growing crops were at least failing to grow as rapidly as they should. On the other hand, throughout the humid region we are accustomed to see crops brought to maturity. These crops may not be so large or of so fine quality as it seems they should; nevertheless, a total crop failure due to lack of moisture is almost unknown. Just what is the extent of the improvement due to irrigation seems very difficult to establish. In general, the process of farming in the humid states is carried on without precise bookkeeping and in the rush of harvest the importance of handling the crop pushes into the background all thought of exact or even comparative yield or value figures as between irrigated and non-irrigated areas in case a farmer has both. The ultimate crop, both from irrigated and non-irrigated areas, goes through the packing house together and it is impossible to determine the relative selling price of the irrigated and non-irrigated product. In the majority of instances, furthermore, if a farmer irrigates his crops he irrigates the entire crop, as far as any one product is concerned, and to compare his returns with those of another farmer using different soils and cultivational practices is quite unfair.

Two committees of the A.S.A.E. have made reports, one in 1931 and one in 1936, on the areas in various states equipped with supplemental irrigation. Table 1 following is taken from these two committee reports using, in both cases, the same 17 states which lie definitely in the humid region. As you may notice, the estimate for 1936 is about three times as large as that for 1931, indicating that the belief in supplemental irrigation is fairly widespread. A further indication of this may be seen in Table 2 which is an assembled report showing contemplated extensions of irrigation systems by truck growers who have irrigated for not less than three years, and includes the last sixteen truck growers that the writer has contacted who are known to have practiced irrigation for three years or longer. The total acreage irrigated in this group is 446, indicating an average of 25 acres apiece, showing that these are rather substantial farmers. This group has practiced

irrigation for an average of over nine years each. As you will note from the table, 7 of the 16 growers contemplate the extension of their irrigation systems this autumn. Although nine growers contemplate no extension of their systems, it should also be noted three out of the nine farmers now have their entire acreage completely equipped.

Table 3 is a similar table concerning the contemplated extensions of their irrigation systems by the last six orchardists contacted by the writer who likewise have irrigated for three years or more. The total acreage now irrigated by these 6 farmers is 655, or an average of 109 acres of orchard each. These orchardists have practiced irrigation for an average of 6 years each. Four orchardists contemplate extending their systems this season.

Assuming that irrigation is contemplated, the question arises - what is the best type of irrigation to install? This is very largely a matter of adjustment between the soil conditions, the available water supply, and the farmer's individual choice (if he has a choice) provided that suitable crops are to be grown under suitable soil conditions and that good markets are available. The importance of the individual who will operate the system may not be overlooked in estimating the probable success of the irrigation venture.

Subirrigation

Subirrigation is perhaps the most attractive form of irrigation in the minds of most people. Where conditions are suitable it is a very excellent type of irrigation but it can be successfully used in so few localities in the United States that it is almost a mistake to include it in this discussion. The prime requisite for such irrigation is a suitably impervious subsoil at a proper depth, a porous top soil, suitable topography, and a plentiful water supply. The impervious subsoil should be located at a depth of from 18 inches to 6 feet, according to the crop grown, the shallower depth for the shallower rooted vegetable crops and the greater depth for orchards and deeper rooted crops.

Surface Irrigation

The simplest system and the least expensive is ordinarily surface irrigation. This system, like all others, has certain limitations, the most important of which is the surface slope. Surface slopes must be sufficient to cause the water to flow but not to cause erosion. In the humid region where farmers are accustomed to see frequent heavy rains on their fields they should make very little error in judging this factor. In this territory, surface irrigation in its simplest form requires a pumping plant and a very short pipe line. This condition is not often met but an irrigation plant consisting of only a pumping plant and a fairly long pipe is common. If the pipe line can be brought to the high part of a ridge it may be possible to run a head ditch on the top of the

ridge to lead water both ways from the pipe discharge and final distribution for truck crops may be made down the middles between the rows. Particularly does this work well if the slope down the rows is slight but quite uniform and the process of cultivation such that the middles between the rows are just slightly depressed. In well cultivated crop land a surface slope of 2/10 foot per 100 feet or less is very satisfactory in many soils.

Such a head ditch as mentioned above is often impossible because of variations in surface slope and it is also considered to be a handicap to the other field activities, whether installed as a permanent ditch or plowed in for each occasion. A head ditch may readily be replaced by a pipe line with suitable hydrants or outlets. From the outlets, hose or pipe may be used to deliver the water to the middles. Outlets about 80 feet apart with 50-foot lengths of hose is one rather satisfactory arrangement, the opening of the hose being moved from middle to middle as irrigation progresses. Portable galvanized iron pipe with gate openings at each middle is also satisfactory in many arrangements. In other instances the distribution of water to the middles is accomplished by means of a trough with notches cut in one side, several middles being irrigated at one time.

In one case where a farmer uses this type of distribution, he brings water to a trough by means of a 2-inch pipe on the surface of the ground and couples an additional length of pipe as he moves the trough across the field. Another farmer, applying surface irrigation on a number of crops including strawberries, is using a large size canvas hose for delivering water to the field. This hose was made from strips of heavy water-proof canvas 24 inches in width, resulting in a hose a little over 7 inches in diameter. He reports finding this a very satisfactory size, the matter of coupling one length to another being a simple matter by thrusting one end of the supply hose into the end of the receiving hose 2 feet or so and counting on the pressure of the water to hold the joint tight. He states that such a joint must be made with the hose lying straight on the ground to make certain that there is no slack on the line near the point of juncture. Furthermore, the assembly must be made when the hose is empty. A larger hose may be used satisfactorily to deliver water to one of smaller diameter but the reverse arrangement would not be satisfactory.

This farmer uses hose up to 300 feet in length and in moving the hose after it has been drained, he simply gathers it up loosely over one arm without attempting to coil or roll it. When he has occasion to move considerable hose equipment to another farm several miles away, he gathers it loosely in the same way into a light truck and upon reaching the other farm, connects the hose to the discharge point of the supply pipe and lets the truck move slowly down the field, paying out the hose over the end as the truck advances. This gives a rough set-up which permits him to start irrigation. He then lays out a second line of hose with care and thus is prepared to continue irrigation in good form after the irrigation from the first line has been completed.

The writer was shown a pile of this hose which was stated to be 8 years old and which had just been sewed the third time because the thread had rotted out although the canvas seemed to be in good condition. This type of hose was reported to be satisfactory for use as conveyor hose up ridges as high as 3 feet or so. This farmer has also recently acquired 1,500 feet of portable flexible joint pipe of one of the more recently developed types which depends on a fish-tail rubber gasket for making a tight connection. This type of pipe will stand considerable pressure and so may be used to get water to the top of many ridges that normally would require a separate permanent branch pipe line.

For the irrigation of orchards much the same conditions prevail, although the handling of the water in the orchards may be somewhat different. In the first place, a pump and pipe line are necessary. For the simplest possible case a short pipe line might serve but generally a long pipe line seems to be necessary. If a single outlet could be located at one high point in an orchard it might be possible to irrigate the whole from one such point by gravity, using header or conveyor ditches to get the water in large streams to suitable points for delivery to the trees. Generally, however, this is neither possible nor desirable. It is seldon that all points of an orchard can be reached by gravity delivery from one place and it is probably poor policy to keep any tree supplied with the amount of excess water that would reach those located near such a single pipe outlet in a large orchard. For that reason one generally finds a number of outlets in an orchard of any size. A good many orchards may be found with outlets several hundred feet apart but apparently outlets closer together, up to every other tree row, are to be preferred. For such outlets many farmers use 2-inch pipe with a cap over the end. Usually in irrigating several outlets are running at a time and it is then a simple matter to remove a cap when irrigation from another outlet is desired, or to close up one when it is desirable to stop irrigation at that point. Often water is led to the middle between the trees at one side of such an outlet until the middle is thoroughly wetted and then the water stream is turned to the middle of the other side. In some instances, after removing the cap a portable valve is put on in place of the cap so that the rate of delivery of water from that outlet may be controlled, and occasionally a valve and a short length of hose is used instead of hoe or shovel work to direct the water stream. Quite commonly the water, in its movement down the middle or down the tree rows, depending upon the irrigation practice in any particular orchard, is guided in its course entirely by hoe and shovel. Often the land is not cultivated between irrigations nor are the little levees and channels built up by the hoe and shovel work disturbed during the course of the season. That makes irrigation a simpler task each time the water is applied.

Overhead Pipe Sprinkling Irrigation

This type of irrigation seems to be pretty well standardized and few changes have recently been noticable. It begins to appear, however, that the greatest number of installations are now using a height of 4 to 4-1/2 feet above the ground for the sprinkler pipes. A number of installations have been observed where pipes previously set at a higher position have been lowered and some that were set lower have been raised. It seems to be a rather satisfactory height both from the standpoint of cultivation, whether by mule or garden tractor, and also a very satisfactory height from the standpoint of cleaning clogged nozzles or servicing oscillators, if such are used. The use of oscillators is increasing and apparently the very compact oscillators are preferred as the longer ones, if left in an unfavorable position, get snagged and damaged during cultivation. A surprising number of installations are providing oscillators for every nozzle line but this seems an unnecessary expense. It is believed that most of the objections to portable oscillators come from the fact that very few irrigators equip themselves properly for the ready installation or removal of such apparatus, the commonest arrangement being to thread and unthread the oscillator into and out of position. Very satisfactory hand-operated coupling fittings are available by means of which the oscillator may be placed in position and water-tight connections made without the use of tools.

Two useful devices for holding the sprinkler pipes on top of supporting posts might be noted. One is an aluminum bar type hanger put out by one of the commercial irrigation companies. It simply is a flat bar on which the pipe may roll in oscillating with ends turned up to keep the pipe from rolling off. It is, of course, a substantially frictionless hanger and is particularly suitable where oscillators are used. The other is cheap equipment primarily of use for hand-turned lines or for very short lines where oscillators are installed. This equipment is made of wood of suitable variety, arranged so that one end of a 6- or 8-inch stick may be slipped into the upright end of a supporting pipe post and a suitable curved depression in which the pipe may rest be made across the top. In practice, they are made two at a time by taking a stick of wood of suitable diameter and 12 to 16 inches long, turning down both ends to form a round part to go into the end of the pipe post with a shoulder to prevent its going into the pipe too far, then boring a hole the same size as the outside of the nozzle pipe crossways through the center of the stick and cutting the two apart in the middle. On one farm they had boiled the wooden hangers in old crank case oil before installing them in the field. Such hangers were found to be very satisfactory for hand-turned lines, but where oscillators are used it is desirable to grease the hangers at the beginning of each season.

Sprinkling Irrigation of the Portable
Flexible Joint-pipe Type

This type of irrigation has recently been developed by several companies. Its widest use so far has been in California but recently the writer has seen this equipment in use on a truck farm in the east. Although the cost of the units of equipment is large, low cost per acre or per irrigation is reported because of the portable feature. Irrigation equipment of this type has been obtained for as low as $30.00 to $40.00 per acre, including the cost of pumping equipment and, in the case of the eastern installation just referred to, the owner estimated that he was able to apply a 2-inch irrigation for $3.00 per acre. Two or three types of quick assembling joints are used. At least two of these systems use a fish-tail rubber gasket to make a tight joint and one uses a ball and socket type of connection.

Nozzles of the whirling spray type are commonly used, and can be obtained in various ranges of coverage but unless the crop being watered requires that the water be broken up into very fine droplets, sprinklers of great range are to be preferred. Sprinklers with a range as large as 50 feet in radius or 100 feet in diameter may be used.

In irrigation of this type observed by the writer the sprinklers apparently had a satisfactory coverage of perhaps 27 or 28 feet radius, or 55 feet diameter of the wetted circle. The type of joint used was somewhat different from the one shown as the bell material was heavier and longer longitudinally, and in each of these bells was inserted a connection fitting for attaching a sprinkler nozzle. As the system was being used, however, every other one of these fittings was plugged or capped and a sprinkler was thus attached to every other one. As the pipe lengths were 20 feet each, it placed the sprinklers at 40-foot intervals along the pipe. The farm using this outfit had two irrigation units, as they called them, each unit consisting of a portable two-wheeled pumping outfit on rubber tires, 500 feet of 6-inch main or header pipe and 1,000 feet of 4-inch distribution or sprinkler pipe pipe and 25 sprinklers. On the day of inspection, the outfit was being used in irrigating spinach. The distributor pipe with the sprinklers in operation was left in one position for two hours and then the engine was shut down and the pipe moved to a new and parallel position 60 feet away from the previous one. The moving crew consisted of four men who carried three lengths of pipe at one time, one man being located at each pipe end. This arrangement provided a man always in the right position to protect a sprinkler from being dragged on the ground and also provided a man at the end to attend to the disconnection from the pipe previously used and one at the assembling end when relaying. This outfit uses a sort of snap hook connection to prevent the pipes blowing apart when pressure is applied to the line.

This farm operates on the basis of two 12-hour shifts but arranges to have one crew operate the two units. In a period of continued drought the owners feel that each unit has a capacity of about 35 acres if the outfit is operated 24 hours per day and they contemplate returning to the first position to start over at the end of a ten-day period. Each unit uses about 2-1/2 gallons of gasoline per hour.

This farm is very favorably situated for this type of irrigation in that it adjoins a river for a considerable distance and, furthermore, several creeks run through the place, allowing opportunities for setting up the equipment. There is a 4-foot rise and fall in tide to contend with but the water is never brackish. In most positions where the pumping unit is set, a small amount of grading has been necessary to get the pipe line up the bank.

Table I

Estimate of Acres Irrigated

		1931	1936
Minnesota		150	895
Wisconsin		40	340
Michigan		2000	7600
Iowa		1000	1000
Illinois		250	630
Indiana		1756	550
Ohio		500	10,000
Delaware	)		10
Pennsylvania	(		300
New York	)		1825
Maryland	(	5700	1150
New Jersey	)		6000
Connecticut	(		355
Massachusetts	)		2000
Rhode Island	(		200
Maine			98
Vermont			7
Total		11,396	33,060

Table 2

Irrigated Truck Gardens

Acres	Years	Extension contemplated	
25	5	Yes	
9	19		No
16	3		No
12	6		No
15	8	Yes	
21	6	Yes	
10	7		No
40	7		No
15	8	Yes	
7	5	Yes	
45	6	Yes	
15	4		No
30	6		No
16	3		No
20	26		No
150 permanent	26	Yes	
Total 446	145	7	9

Average 28 acres 9 years each

Table 3

Irrigated Orchards

	Acres irrigated	Years	Extension contemplated	
	140	9	Yes	
	140	8	Yes	
	75	6		No
	75	5		No
	140	5	Yes	
	85	3	Yes	
Total	655	36	4	2

Average 109 6 each